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Research paper

A Heuristic Approach to Obtain an Optimal Solution for Unbalanced Transportation Problem

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Abstract

This Method is proposed for obtaining an optimal solution for transportation problem. This method gives the optimal solution in lesser iteration. Here find the difference between two consecutive maximum for row-wise and column-wise. In that find the maximum value, for which the minimum is allocated by the minimum supply or demand. Illustration for this method is given with some examples at the end.

Keywords: *Transportation problems, supply, Demand, Direct method, optimization*

1. Introduction

Known to be formative methods of linear programming problem is the transportation problem which deals transporting between one point to another, in other words being referred as source and destination. Primary objective of the study is to identify economically viable option which provides the way to transport commodity from source to destination in minimized cost. The caveat here is to be able to maintain the supply and demand requirements. Hitchcock (in 1941) has first developed the transportation problem. This was followed by Charnes, Cooper and many more other authors of with their own algorithms. It can be observed in order to obtain feasible solutions involves two stages, in the former stage basic initial feasible solution and in the latter stage optimal solutions are to be obtained. This study of paper promulgates a new algorithm to determine optimal solution with little iteration without initial basic feasible option. Thereby this method makes it possible to derive solutions in lesser time.

2. Mathematical form of Transportation Problem

The transportation problem can be formulated as an LP problem. Let X_{ij}, i=1…..m, j = 1 ….. n be the number of units transported from source i to destination j.
The LP problem is as follows
Minimize Z $=\sum_{i=1}^{m}\sum_{j=1}^{n} C_{ij}\, X_{ij}$
Subject to the constraints
$\sum_{j=1}^{n} X_{ij} \le S_i$ For all i
$\sum_{i=1}^{m} X_{ij} \ge d_j$ For all j
$X_{ij} \ge 0$
A transportation problem is said to be balanced if
$\sum_{i=1}^{m} \boldsymbol{S_i} = \sum_{j=1}^{n} \boldsymbol{d_j}$

3. Algorithm

Step 1
For the given data construct a transportation table. If the problem is unbalanced make it as a balanced one.
Step 2
Subtract the smallest element from each row to all other elements in that row.
Step 3
Subtract the smallest element from each column to all other elements in that column.
Step 4
For all the zeros present in the matrix and the total sum of rows and columns. In that pick the maximum value and allocate
Minimum supply/demand to that cell .The row and column of that element where the supply/demand is satisfied is deleted.
Step 5
If the maximum value is repeated many times ,then zero which has minimum supply/demand can be allocated.
Step 6
Till all the supply and demand get exhausted the process is repeated from steps 2 and 4.
Step 7
The total minimum cost is calculated by
Total cost = $\sum_{i=1}^{n}\sum_{j=1}^{n} C_{ij}\, X_{ij}$

4. Numerical Examples

Example 4.1

A company has three factories and four distribution centers.

Table 1: Data Table for the Problem

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Factories		Distribution			Supply
		A	B	C	
	S_1	6	10	14	50
	S_2	12	19	21	50
	S_3	12	15	17	50
	Req.	30	40	55	

Find the minimum transportation cost.

Step 1:

The given problem is unbalanced. Make it balanced by adding the dummy column with zero as entries.

Table 2: Balanced Data Table for the Problem

Factories		Distribution				Supply
		A	B	C	D	
	S_1	6	10	14	0	50
	S_2	12	19	21	0	50
	S_3	12	15	17	0	50
	Req.	30	40	55	25	

Step 2:

Table 3: First Iteration for the given Problem

Factories		Distribution				Supply
		A	B	C	D	
	S_1	15 0	13 0	10 0	0 0	50
	S_2	6	9	7	22 0 (25)	~~50~~ 25
	S_3	9	4	3	16 0	50
	$Req.$	30	40	55	25	

In the above table for the entire zeros the sum of row and column is calculated and written in the left corner. In that the maximum value 22 is got allocated with minimum supply/demand 25. Delete the column D since the supply is exhausted.

Step 3:

Table 4: Second Iteration for the given Problem

Factories		Distribution			Supply
		A	B	C	
	S_1	6 0	4 0	1 0	50
	S_2	10 0 (25)	3	1	~~25~~
	S_3	6	1	8 0	50
	$Req.$	~~30~~ 5	40	55	

Step 4:

Table 5: Final Iteration for the given Problem

Factories		Distribution			Supply
		A	B	C	
	S_1	6 0 (5)	1 0 (40)	0 0 (5)	50
	S_3	6	1	7 0 (50)	50
	$Req.$	~~30~~ 5	40	55	

Step 5:

Table 6: Cell Allocation for the given Problem

Factories		Distribution				Supply
		A	B	C	D	
	S_1	6 (5)	10 (40)	14 (5)	0	50
	S_2	12 (25)	19	21	0 (25)	50
	S_3	12	15	17 (50)	0	50
	Req.	30	40	55	25	

Minimum cost = $6 \times 5 + 10 \times 40 + 14 \times 5 + 12 \times 25 + 0 \times 25 + 17 \times 50$

Minimum cost = 1650

5. Conclusion

The direct method towards solving transportation problem is dealt in this research paper. This research work is applicable for all of its kind. This is a methodical way of providing an efficient solution in fewer steps, in addition this method is similar to MODI method where the degeneracy does not occurs. Salient feature of this method is in its advantage of less time taken in reaching the objective of this method. As a result we propose this method to be a unique solution to the problem previously thus developed.

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